Climate Change Vulnerability Index Report

Silene seeleyi (Seely's catchfly)

Date: 15 October 2021

Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington Heritage Rank: G3/S3

Index Result: Moderately Vulnerable Confidence: High

Climate Change Vulnerability Index Scores

Section A: Local Climate	**Severity**	**Scope (% of range)**
1. Temperature Severity	>6.0° F (3.3°C) warmer	0
	5.6-6.0° F (3.2-3.3°C) warmer	0
	5.0-5.5° F (2.8-3.1°C) warmer	0
	4.5-5.0° F (2.5-2.7°C) warmer	0
	3.9-4.4° F (2.2-2.4°C) warmer	100
	<3.9° F (2.2°C) warmer	0
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	18.75
	-0.074 to -0.096	62.5
	-0.051 to -0.073	18.75
	-0.028 to -0.050	0
	>-0.028	0
Section B: Indirect Exposure to Climate Change		**Effect on Vulnerability**
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Somewhat Increase
2b. Distribution relative to anthropogenic barriers		Neutral
3. Impacts from climate change mitigation		Neutral
Section C: Sensitivity and Adaptive Capacity		
1. Dispersal and movements		Increase
2ai Change in historical thermal niche		Somewhat Increase
2aii. Change in physiological thermal niche		Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Somewhat Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Somewhat Increase
3. Restricted to uncommon landscape/geological features		Somewhat Increase
4a. Dependence on others species to generate required habitat		Neutral
4b. Dietary versatility		Not Applicable
4c. Pollinator versatility		Unknown
4d. Dependence on other species for propagule dispersal		Neutral
4e. Sensitivity to pathogens or natural enemies		Neutral
4f. Sensitivity to competition from native or non-native species		Neutral/Somewhat Increase
4g. Forms part of an interspecific interaction not covered above		Neutral
5a. Measured genetic diversity		Unknown

5b. Genetic bottlenecks	Unknown
5c. Reproductive system	Neutral
6. Phenological response to changing seasonal and precipitation dynamics	Neutral
Section D: Documented or Modeled Response	
D1. Documented response to recent climate change	Neutral
D2. Modeled future (2050) change in population or range size	Unknown
D3. Overlap of modeled future (2050) range with current range	Unknown
D4. Occurrence of protected areas in modeled future (2050) distribution	Unknown

Section A: Exposure to Local Climate Change

A1. Temperature: All 14 of the extant and historical occurrences of *Silene seelyi* in Washington (100%) occur in areas with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

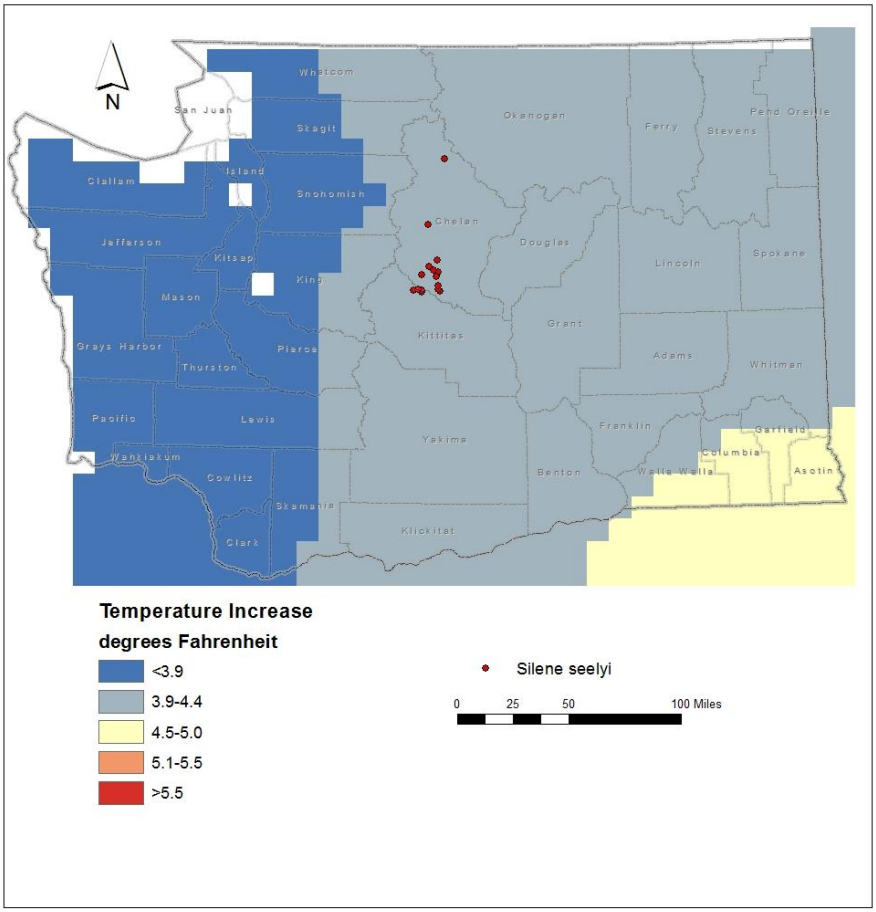

Figure 1. Exposure of *Silene seelyi* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: Ten of the 16 occurrences (62.5%) of *Silene seelyi* in Washington are found in areas with a projected decrease in available moisture (as measured by the ratio of actual to potential evapotranspiration) in the range of -0.074 to -0.096 (Figure 2). Three populations (18.75%) are from areas with a projected decrease of -0.051 to -0.073 and three others (18.75%) have a projected decreases of -0.097 to -0.119 (Figure 2).

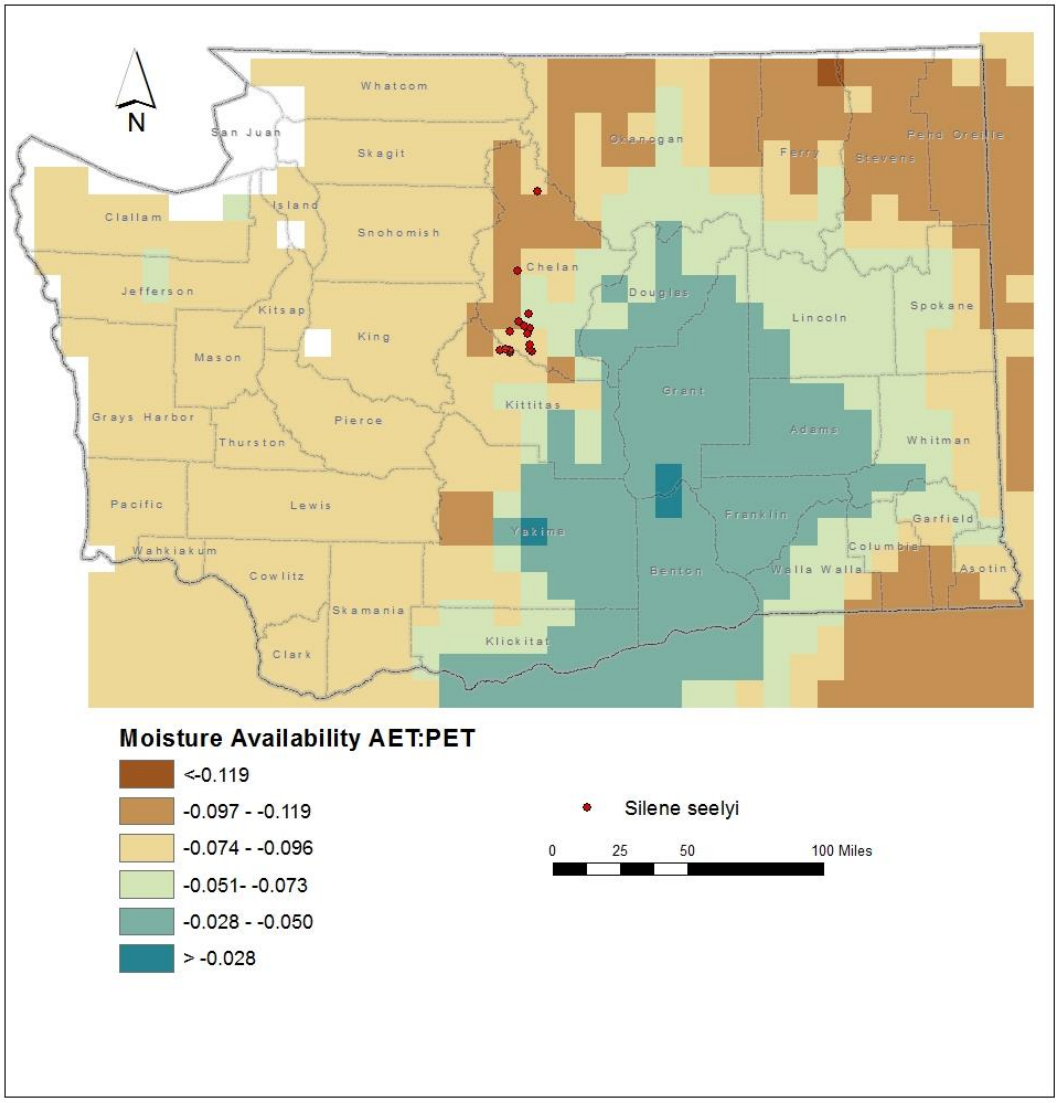

Figure 2. Exposure of *Silene seelyi* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Silene seelyi* are found at 1120-6300 feet (340-1920 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Somewhat Increase.
Silene seelyi occurs primarily in shady crevices of cliffs, rock outcrops, and boulder fields with thin soil and sparse vegetation within Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) forests (Camp and Gamon 2011, Washington Natural Heritage Program 2021). This habitat is part of the North Pacific Serpentine Barren and Rocky Mountain Cliff, Canyon, & Massive Bedrock ecological systems (Rocchio and Crawford 2015). The entire range of the species is restricted to an area of 12 x 60 miles (20 x 98 km), with populations separated by 0.8-30 miles (1.3-49 km). Available habitat is patchy throughout its range, with populations isolated by narrow canyons or expanses of forest. Natural barriers represent an impediment to dispersal.

B2b. Anthropogenic barriers: Neutral.
The rock outcrop and talus habitat of *Silene seelyi* is located in National Forest lands managed primarily for multiple use, including recreation and forestry. The rugged terrain inhabited by the species largely protects it from most direct human impacts. Anthropogenic barriers are minor relative to natural ones.

B3. Predicted impacts of land use changes from climate change mitigation: Neutral.

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Increase.
Silene seelyi produces numerous, small seeds within a dry capsule fruit that splits open at maturity along 6 sutures to release the seeds passively. Seeds are flattened but lack wings, hooks, or feathery hairs for dispersal by animals or wind. Dispersal distances are probably 10-100 m.

C2ai. Historical thermal niche: Somewhat Increase.
Figure 3 depicts the distribution of *Silene seelyi* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All 16 known occurrences in the state (100%) are found in areas that have experienced slightly lower than average (47.1-57˚F/26.3-31.8˚C) temperature variation during the past 50 years and are considered at somewhat increased vulnerability to climate change (Young et al. 2016).

C2aii. Physiological thermal niche: Increase.
Silene seelyi is found primarily in shaded crevices of boulders and rock outcrops (often on north-facing aspects) within narrow canyons that have cold air drainage. These microhabitats are at increased susceptibility to climate change.

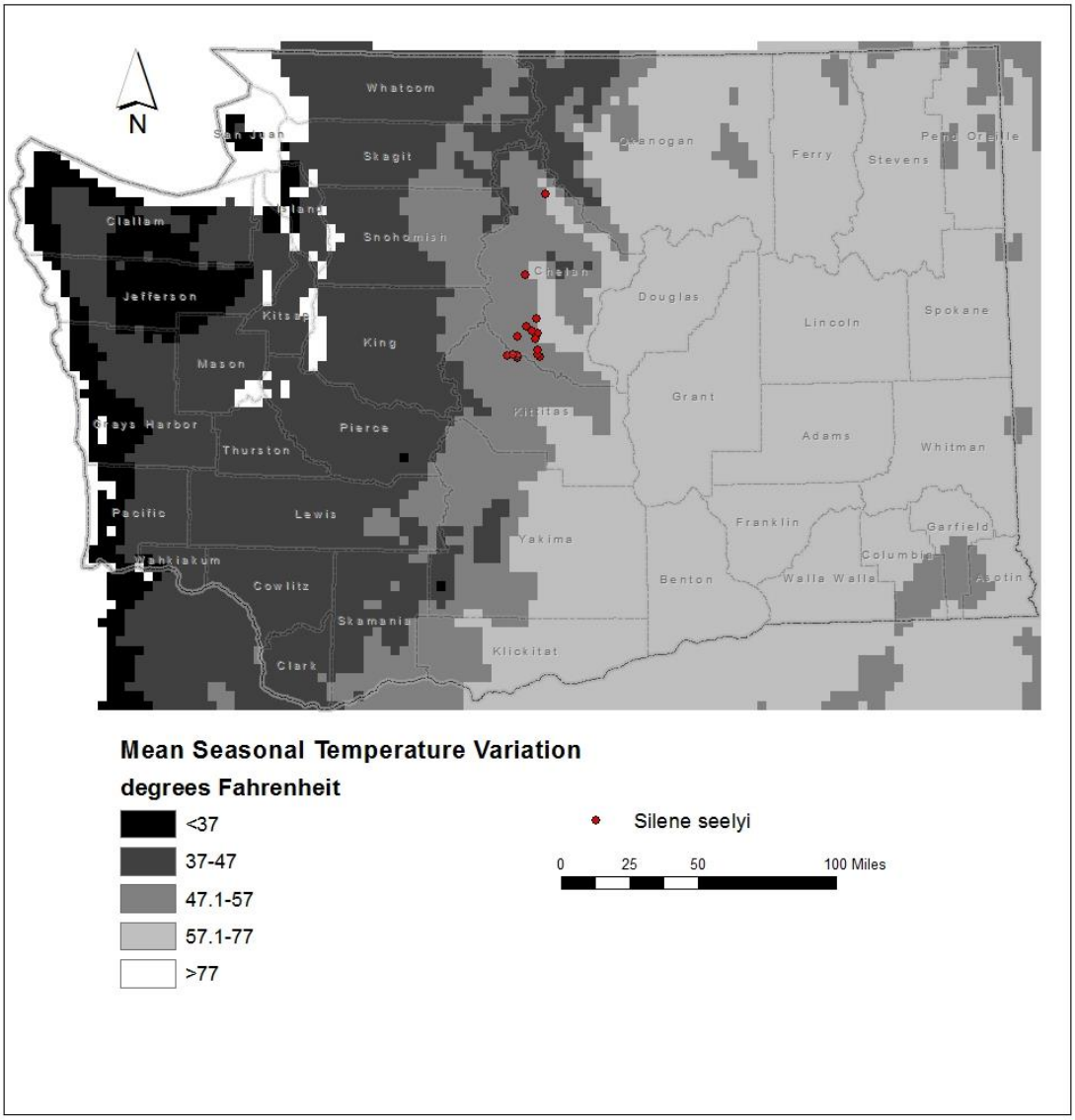

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Silene seelyi* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bi. Historical hydrological niche: Neutral.

All of the known populations of *Silene seelyi* are found in areas that have experienced average or greater than average precipitation variation in the past 50 years (>20 inches/508 mm) (Figure 4). According to Young et al. (2016), these occurrences are neutral for climate change.

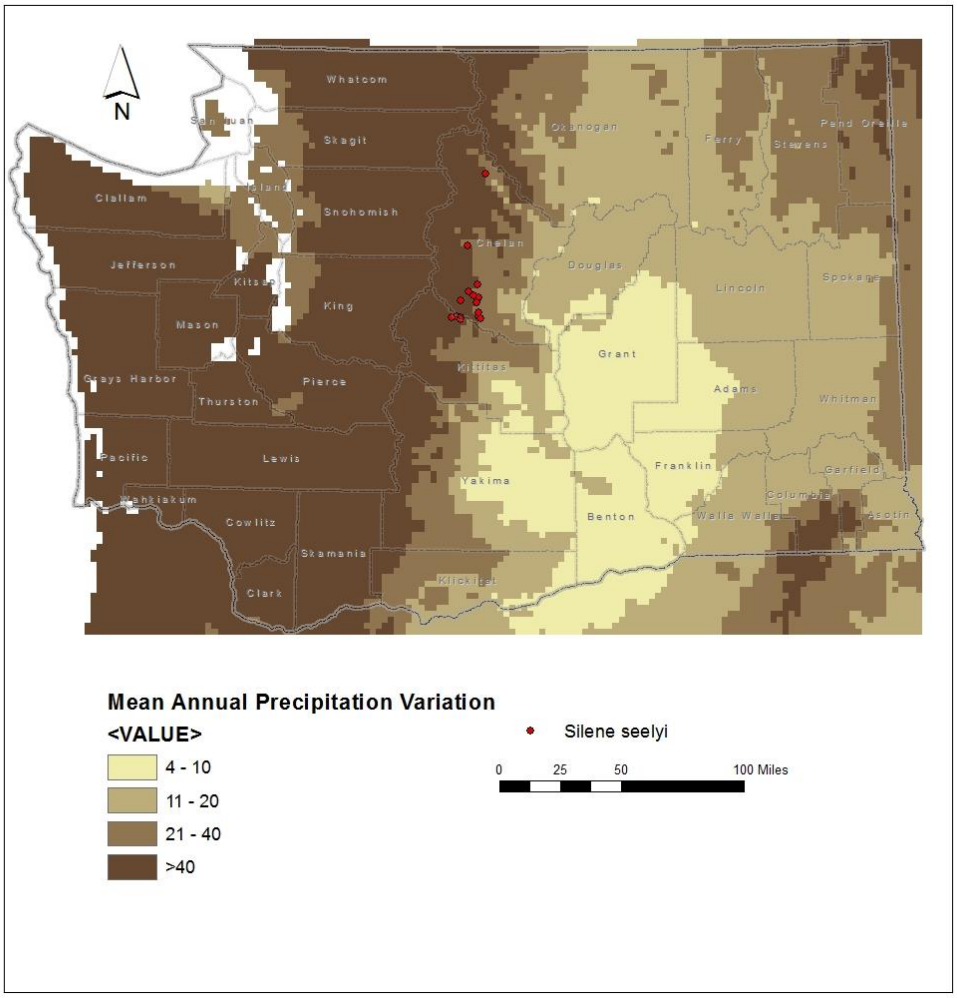

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Silene seelyi* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
This species is not associated with perennial water features or a high water table, and is dependent on winter snow and spring/summer rain for its moisture needs. Changes in the timing or amount of precipitation could result in drying of its rock outcrop habitat and make surrounding forests more prone to wildfire (Rocchio and Ramm-Granberg 2017), reducing shade and making cliff microsites drier.

C2c. Dependence on a specific disturbance regime: Neutral.
Silene seelyi occurs in montane cliffs and rock outcrops subject to periodic rockfall due to erosion, earthquakes, freeze-thaw activity, and vegetation growth. These are natural processes that are unlikely to be altered by projected climate change.

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
Populations of *Silene seelyi* are found in shady mountain canyons that receive high amounts of winter snow and ice. Water infiltrating cracks and crevices in rock outcrops is an important moisture source during the growing season. Reductions in the amount of snowfall, or the timing of its melting due to climate change (Rocchio and Ramm-Granberg 2017) could have a negative impact on this species.

C3. Restricted to uncommon landscape/geological features: Somewhat Increase.
Silene seelyi is found on a variety of geologic substrates, including serpentine (Ingalls complex), basalt (Mt Stuart Batholith), gneiss (Skagit Formation), fluvial sediments (Swauk Formation), and Quaternary landslides (Washington Division of Geology and Earth Resources 2016). Several of these formations are restricted to the Wenatchee Mountains and vicinity. This species may be more dependent on the presence of exposed rock than its mineralogy or chemistry.

C4a. Dependence on other species to generate required habitat: Neutral
The rock outcrop habitat occupied by *Silene seelyi* is maintained by natural abiotic conditions.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Unknown.
The specific pollinators of *Silene seeleyi* are not known. Having dark red to purplish flowers, *S. seelyi* might be hummingbird pollinated, as are other red-flowered *Silene* species (Reynolds et al. 2009). Flowers may also be white, which would attract a variety of insect pollinators.

C4d. Dependence on other species for propagule dispersal: Neutral.
Seeds of *Silene seelyi* are released passively and may disperse by gravity or short distances by strong winds. Secondary, short-distance, dispersal may be possible by insects or rodents collecting seeds.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known, but probably not a limiting factor. Herbivory appears to be insignificant.

C4f. Sensitivity to competition from native or non-native species: Neutral/Somewhat Increase.
Under present conditions, competition from non-native species is minor, as few introduced plants are adapted to bare, shady surfaces of cliffs or talus. Under projected climate change, competition from invasive weeds could increase if these rocky sites become more exposed due to wildfire removing surrounding forest cover (Rocchio and Ramm-Granberg 2017).

C4g. Forms part of an interspecific interaction not covered above: Neutral.
Does not require an interspecific interaction.

C5a. Measured genetic variation: Unknown.
No data are available on genetic variability.

C5b. Genetic bottlenecks: Unknown.
Not known.

C5c. Reproductive System: Neutral.
Silene seelyi is a diploid (n = 12) (Popp and Oxelman 2007) and appears to be an obligate outcrosser. Kruckeberg (1961) conducted hybridization experiments in greenhouse settings and found *S. seelyi* to be capable of hybridizing and producing some fertile F1 progeny with the related tetraploid *S. menziesii* and diploid *S. williamsii* (native to Alaska and NW Canada). *Silene menziesii* occurs widely across Washington and western North America, but does not co-occur with *S. seelyi* in the Wenatchee Mountains, suggesting that any gene flow in nature is unlikely.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records in the Consortium of Pacific Northwest Herbaria website (pnwherbaria.org), *Silene seelyi* has not changed its typical blooming time over the past 90 years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No major changes have been detected in the distribution of *Silene seelyi* in Washington since it was first discovered in the state in 1932.

D2. Modeled future (2050) change in population or range size: Unknown

D3. Overlap of modeled future (2050) range with current range: Unknown

D4. Occurrence of protected areas in modeled future (2050) distribution: Unknown

References

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